Before the
FEDERAL COMMUNICATIONS COMMISSION FCC 93-547
Washington, D.C. 20554

In the Matter of

Amendment of Section 2.106 of the Commission's Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites	)	ET Docket NO. 92-28
	)	RM-7771, RM-7773
	)	RM-7805, RM-7806
	)	RM-7927

REPORT AND ORDER

Adopted: December 13, 1993; Released: January 12, 1994

By the Commission:

TABLE OF CONTENTS

INTRODUCTION

1. By this Report and Order, the Commission is allocating 33 megahertz of spectrum, 1610-1626.5 and 2483.5-2500 MHz, for the mobile-satellite service (MSS). This allocation is identical to that adopted internationally by the 1992 World Administrative Radio Conference (WARC-92). This new spectrum will support the growing demand for mobile communications, both domestically and internationally. This allocation will permit the introduction of new mobile satellite services, including voice, facsimile, and data applications, and facilitate the availability of such services on a worldwide basis. The MSS services expected to use this spectrum include cellular telephone-like services, personal locator services, data messaging, inventory control, and fleet monitoring. In addition, this MSS spectrum may be used to offer important public safety applications by extending mobile communications capability to rural and remote areas for the first time. Internationally, global MSS applications have the potential to make modern telephone type communications services available for the first time to many underserved areas of the world.

BACKGROUND

2. The bands proposed for MSS, 1610-1626.5 and 2483.5-2500 MHz, currently are allocated to a number of other services. The radiodetermination satellite service (RDSS), which encompasses both radionavigation and radiolocation satellite services,[1] are allocated the bands on a primary basis but only interim RDSS systems have been authorized.[2] The 1610-1626.5 MHz band is allocated to the aeronautical radionavigation service on a co-primary basis, and the 1610.6-1613.8 MHz segment of this band also is allocated to the radio astronomy service (RAS) on a secondary basis. Frequencies adjacent to the 1610-1626.5 MHz

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[1] See Table of Frequency Allocations, 47 C.F.R. § 2.106. The 1610-1626.5 and 2483.5-2500 MHz bands currently are allocated for RDSS Earth-to-space and space-to-Earth transmissions, respectively.

[2] No dedicated RDSS space stations are operating. We have authorized interim RDSS operations to Newcomb Communications, Inc., and Mobile Data Communications, Inc., in the 1610-1626.5 MHz band using the GTE Spacenet fixed-satellite system. Those authorizations require the licensee to terminate transmissions when an MSS "Above 1 GHz" system is launched and is ready to begin operations. See Newcomb Communications, Inc., 8 FCC Rcd 3631 (1993); letter to Counsel, Mobile Data Communications, Inc. from Chief, Domestic Facilities Division (August 19, 1993).

band are allocated to aeronautical radionavigation satellite and maritime mobile satellite services.

3. The 2483.5-2500 MHz band is authorized for co-primary use by the broadcast auxiliary service, the terrestrial fixed service, and the industrial, scientific and medical (ISM) service. Additionally, the frequencies adjacent to this band are allocated to the instructional television fixed service (ITFS), the multi-channel multi-point distribution service (MMDS), fixed services, mobile services and the ISM service on a primary basis; and to the radiolocation service on a secondary basis.

4. Five parties filed Petitions for Rule Making seeking to operate LEO MSS systems on all, or portions of, the RDSS bands.[3] The parties requesting allocation of this spectrum for LEO use are Ellipsat Corporation (Ellipsat), Loral/Qualcomm Satellite Services, Inc. (Loral), TRW, Inc. (TRW), Constellation Communications, Inc. (Constellation) and Motorola Satellite Communications, Inc. (Motorola). These parties propose to provide a variety of services, including position determination and reporting; telephone, data and facsimile transmission; and fleet surveillance and control for the transportation and public service communities.

5. According to the petitioners, LEO satellite operations could provide these services in areas where such services are not practical using conventional terrestrial or geostationary satellite communications systems. The parties argue that providing services by using LEOs will be less costly than using GEO satellites and that these services can be provided worldwide using a single LEO system. A variety of satellite system designs was proposed by the five LEO proponents. They range from Ellipsat's six satellite/single orbit system to Motorola's 66 satellite/six orbit system. The proposed LEO systems also vary in the access method to be used: Ellipsat, Loral and TRW propose code division multiple access (CDMA) digital spread spectrum technology; Constellation proposes both CDMA and frequency division multiple access (FDMA); and Motorola proposes FDMA and time division multiple access (TDMA) techniques.

6. Two additional Petitions for Rule Making were filed, one by the American Mobile Satellite Corporation (AMSC) and one by CELSAT, Inc. (CELSAT). Both of these petitioners request that the bands be allocated for GEO MSS use. AMSC, the U.S. domestic MSS licensee in the 1545-1559 and 1646.5-1660.5 MHz bands, requests that the Commission allocate for GEO MSS the 1616-1626.5 MHz band with the 1515-1525 MHz band and assign these frequencies

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[3] These Petitions for Rule Making were associated with applications to construct LEO satellites.

to AMSC.[4] AMSC stated that it needs these bands to expand its planned MSS system because of problems in coordinating internationally its currently assigned channels. CELSAT requests that both the 1610-1626.5 and 2483.5-2500 MHz bands be allocated for a new hybrid satellite and terrestrial personal communications service. CELSAT's proposed service would combine mobile-satellite service provided through a satellite in geostationary orbit with new terrestrial cellular-like service operating in this same spectrum to create a system of overlapping space and ground cells.

7. In February 1992, based upon a U.S. proposal,[5] WARC-92 established a co-primary allocation for MSS at 1610-1626.5 and 2483.5-2500 MHz.[6] This allocation permits the operation of high speed data and voice MSS on these frequencies. WARC-92 also upgraded to co-primary status the secondary allocation for the RAS at 1610.6-1613.8 MHz.

8. In response to these petitions and to the decisions of WARC-92, in the Notice of Proposed Rule Making and Tentative Decision (Notice) we proposed to allocate the 1610-1626.5 and 2483.5-2500 MHz bands to the mobile-satellite service, including both LEO and GEO MSS systems.[7] The 1610-1626.5 MHz band was proposed for Earth-to-space operations, and the 2483.5-2500 MHz band for space-to-Earth operations. We also proposed to allow space-to-Earth operations in the 1613.8-1626.5 MHz band on a secondary basis to accommodate bi-directional MSS operations. Further, in the 1610.6-1613.8 MHz band we proposed to elevate the existing secondary allocation for the radio astronomy service to co-primary status as adopted internationally at WARC-92. We also proposed to require that MSS operations comply with the power-related limits contained in the international Radio Regulations. In addition, we declined to propose specific new allocations for MSS feeder links, stating that the current fixed satellite bands

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[4] The Commission did not propose to allocate the 1515-1525 MHz band in the Notice of Proposed Rule Making because of the current use of the band by the aeronautical telemetering community.

[5] See United States Delegation Report, World Administrative Radio Conference, International Telecommunication Union, Malaga-Torremolinos, Department of State Publication 9988 (July 1992).

[6] See International Telecommunications Union, Final Acts of the 1992 World Administrative Radio Conference (Final Acts), Malaga-Torremolinos (1992).

[7] See Notice of Proposed Rule Making and Tentative Decision, ET Docket No. 92-28, 7 FCC Rcd 6414 (1992).

should be sufficient for such use.[8] Finally, we proposed allocations in the 24 and 28 GHz bands for the inter-satellite service to accommodate inter-satellite links for MSS systems.[9]

9. In December 1992, we established the MSS Above 1 GHz Negotiated Rule Making Committee (MSS NRMC) to provide expert advice and to make recommendations on technical and operational matters related to establishing MSS in the RDSS bands.[10] The Committee's sixteen members included all seven MSS applicants, other users of the RDSS and adjacent bands, and a potential equipment manufacturer.[11] The Committee's work included technical matters relating to compatibility among the proposed MSS systems (intra-system sharing issues), compatibility between MSS and other services in the RDSS or adjacent bands (inter-service sharing issues) and operations of MSS feeder and inter-satellite links. The MSS NRMC reached a consensus with regard to many of these issues and published proposals for rules and policies in its "Report to the Commission" (MSS NRMC Report).[12]

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[8] "Feeder links" are transmission links between a fixed Earth station and a satellite. MSS feeder links include both uplinks and downlinks.

[9] "Inter-satellite links" are transmission links directly between satellites, with no intervening Earth station.

[10] The MSS NRMC was established as an advisory committee to assist with our Negotiated Rule Making proceeding in CC Docket No. 92-166 addressing the applications to construct satellites for operation of MSS services in the RDSS bands. This committee was established pursuant to the Federal Advisory Committee Act, 5 U.S.C. App. 1, and the Negotiated Rule Making Act of 1990 (NRA), 5 U.S.C. §§ 581, et seq., Pub. L. No. 101-648. See Public Notice, Report No. DS-1265, 7 FCC Rcd 8614 (1992). The Committee first met on January 6, 1993, and issued its Report at its conclusion on April 6, 1993, see infra note 12.

[11] The MSS NRMC members included representatives from AMSC, CELSAT, Ellipsat, Motorola, Constellation, TRW, Loral Qualcomm, the Federal Aviation Administration (FAA), the National Academy of Sciences - National Research Council's Committee on Radio Frequencies (CORF), the National Aeronautics and Space Administration (NASA), the Wireless Cable Association International, Inc., Rockwell International Corporation, the Communications Satellite Corporation (Comsat), the U.S. Army and Aeronautical Radio, Inc. (ARINC).

[12] "Report of the MSS Above 1 GHz Negotiated Rule Making Committee," April 6, 1993, CC Docket No. 92-166. The NRA defines "consensus" as unanimous concurrence among the interests represented on the Committee, although it permits the Committee

The Committee did not succeed in efforts to develop an inter-system sharing proposal that would allow all of the proposed MSS systems to be accommodated in the 33 megahertz of spectrum proposed to be allocated. Instead, two independent attachments were included in the Committee Report that address inter-system sharing issues.[13]

DISCUSSION

10. Allocation of Spectrum. In the Notice we observed that there appears to be substantial interest in using the 1610-1626.5 and 2483.5-2500 MHz bands for MSS applications. We noted that the services to be provided by the proposed MSS LEO systems appear to offer significant new benefits to both domestic and international communications users. In this regard, we observed that MSS LEO systems offer the flexibility of a universally available worldwide cellular-like telephone service for voice and data communications in addition to radiolocation and navigation service. We also recognized that there is interest in using these bands for MSS GEO operations. We tentatively concluded that, because of the important economic and service innovations that could be provided by both MSS LEO and MSS GEO systems, it is important to provide an opportunity for these services to develop.[14] We further noted that allocation of these bands for MSS would be identical to the international allocation at these frequencies for MSS established at WARC-92. We therefore proposed to establish new primary allocations at 1610-1626.5 and 2483.5-2500 MHz for mobile satellite services. We stated that allocating these bands to MSS would provide the maximum flexibility in considering the several MSS petitions before us by

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to agree on another specified definition. 5 U.S.C. § 562(2). The Committee defined consensus as unanimous concurrence, but agreed that if unanimity could not be reached the situation would be described in the Committee Report.

[13] See "Final Report of the Majority of the Active Participants of Informal Working Group 1 to the Above 1 GHz Negotiated Rule Making Committee, Annex 1/Attachment 1 to Committee Report" (Annex 1/Attachment 1) and "Report of Motorola on Band Segmentation Sharing to Working Group 1 of the Above 1 GHz Negotiated Rule Making Committee, Annex 1/Attachment 2 to the Committee Report" (Annex 1/Attachment 2).

[14] We also noted the petitioners' view that the proposed 33 MHz of spectrum may not be sufficient to accommodate all of the MSS applicants at the proposed levels of service.

permitting operation of both LEO and GEO MSS operations. We also tentatively concluded that the public interest would be served best by providing for multiple MSS operators.

11. In the Notice we also recognized significant concerns about the feasibility of MSS LEO and MSS GEO operations sharing the same frequencies. In particular, we noted that sharing these bands by LEO and GEO systems may require limits on power and frequency that could render both types of systems unworkable. We requested information on this issue to enable us to evaluate the relative merits of the CDMA spread spectrum, TDMA and FDMA access schemes proposed by the MSS proponents and to determine whether it is feasible to permit both CDMA and a combined TDMA/FDMA system to share the same spectrum. We also requested comment on these access methods to the extent that they might affect the allocation of the subject spectrum and competition among systems using this spectrum.[15]

12. The commenting parties generally support our proposal to allocate the 1610-1626.5 and 2483.5-2500 MHz bands for MSS use. For example, the American Petroleum Institute (API) states that this spectrum is needed to meet a growing demand for mobile voice, facsimile, data messaging, and fleet surveillance and control services. Motorola states that allocating this spectrum as proposed will help meet the increasing demand for MSS services, implement decisions made at WARC-92, and significantly advance the efficient and effective use of this spectrum by increasing the types of services that can be provided to include voice and data messaging as well as the position determination type services for which the spectrum currently is allocated. Motorola further states that allocating spectrum for provision of these services will foster U.S. competitiveness and help maintain the U.S. lead with regard to non-geostationary MSS technology. Motorola submits that the proposed allocations also will foster communications technologies that enhance the safety of life and property by permitting the operation of personal locator services that can be used in emergency situations such as for search and rescue of lost hikers and campers.

13. The MSS proponents state that they intend to provide both MSS and RDSS services. TRW, for example, states that it anticipates that RDSS applications will be a significant percentage of its user volume. TRW explains that it expects to provide tracking services to businesses needing to track inventory and to freight carriers needing to monitor items in transit. TRW further states that it expects organizations that

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[15] We stated that we intended to consider in a subsequent proceeding whether it may be necessary to limit operations in this spectrum to a specific type of access method in order to maximize sharing possibilities.

must maintain constant communication with personnel, such as municipal, local, and state governments providing emergency services related to citizen safety, to take advantage of this new mobile service. TRW further contends that cellular service providers interested in augmenting and expanding the coverage areas of their systems or filling gaps in coverage may utilize these services to meet such requirements. TRW concludes that there is a significant untapped demand for satellite systems providing ubiquitous global telecommunications service to hand-held units such as those envisioned in its proposed system.[16] The LEO proponents generally state that compared to geostationary satellites, the lower power requirements of non-geostationary satellites should result in lower operating costs for the hand-held devices associated with their systems.

14. The GEO proponents state that they plan to provide services similar to those proposed by non-geostationary proponents. CELSAT proposes a personal communications service that would provide mobile service using both satellite and terrestrial stations. AMSC states that it plans to provide services that include voice communications and position determination to the trucking, railroad, and petroleum industries using mobile units.

15. No comments opposed the proposed allocation for MSS. However two parties, AMSC and the National Academy of Sciences through the National Research Council's Committee on Radio Frequencies (CORF), express concern about possible harmful interference from MSS operations to other services with primary allocations in and adjacent to the 1610-1626.5 and 2483.5-2500 MHz bands. These parties are concerned particularly with possible harmful interference to the radio astronomy and aeronautical radionavigation services, both of which share portions of the 1610-1626.5 MHz band.

16. Both the LEO and GEO proponents acknowledge that using the same spectrum for both geostationary and non-geostationary operations will require substantial limitations on both power and frequency. For this reason, the proponents on both sides argue that we should limit the proposed MSS allocation to either LEO or GEO operation, their preference depending upon the type system they propose. The MSS NRMC considered this issue and concluded that MSS sharing between LEO and GEO systems is possible if both types of systems use the same access techniques and if the sharing is limited to frequencies not used for bi-directional operations.

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[16] TRW estimates that eventually it will have up to 2 million customers and could establish a viable satellite service with up to two other competing satellite systems in operation.

17. Based on the record in this proceeding, we find that there is substantial interest in using both LEO and GEO technologies to provide new voice and data MSS services in the subject bands. As we indicated in the Notice, MSS LEO systems will offer significant new benefits to both domestic and international communications users. MSS LEO systems potentially can provide a universally available world-wide cellular-like radiotelephone service offering voice, data, and facsimile services. In addition, radiolocation and radionavigation applications also can be provided. Some of the new applications envisioned include:

* Personal Locator Services - Such services could be used to locate accident victims or persons stranded because of weather or injury.

* Fleet Management and Tracking Services - Such services would permit more efficient shipping and transportation of goods, including the tracking of hazardous wastes and material.

* Public Safety Services - State and local governments may use MSS to extend health and emergency services to rural and remote areas currently unserved by traditional communications facilities.

* International Services - Global MSS applications have the potential to make modern telephone communications available to the remote and underserved areas of the world.

The low power requirements of MSS LEO space stations and their associated portable ground units that would operate in these bands are expected to result in these new services being available at relatively low cost. Moreover, it appears that recent advances in both satellite and ground transceiver technology will make it possible to provide voice and data services with RDSS services in this spectrum. We conclude that the demand for additional MSS services warrants this spectrum allocation and that the 1610-1626.5 and 2483.5-2500 MHz bands are suitable for supporting the proposed services.

18. Based on the comments, we also conclude that it is possible for LEO and GEO satellite systems to share the available spectrum with each other and with other existing services using the bands if appropriate sharing constraints are applied to MSS operations. Accordingly, we are allocating the 1610-1626.5 and 2483.4-2500 MHz bands for MSS use, including both MSS LEO and MSS GEO operations, on a co-primary basis with the existing primary services in these bands. Consistent with WARC-92, we also are upgrading the radio astronomy service in our domestic Table of

Frequency Allocations from secondary to primary service in the 1610.6-1613.8 MHz band.[17]

19. Bi-directional Operations. In the Notice we proposed a primary MSS allocation for uplink operations in the 1610-1626.5 MHz band and a secondary allocation for downlink operations in the 1613.8-1626.5 MHz sub-band.[18] We expressed concern, however, that bi-directional use might not be feasible because of possible harmful interference to radio astronomy services in the adjacent 1610.6-1613.8 MHz portion of the band and to the GLONASS system that is operating up to 1616 MHz, and might complicate coordination among the proposed systems themselves.

20. As part of its investigation of the inter-service sharing issues, the MSS NRMC analyzed sharing between a secondary MSS downlink operation at 1613.8-1626.5 MHz and both the RAS and the GLONASS radionavigation system. It concluded that RAS operations could be protected using techniques such as limiting power flux density, filtering transmitters, and establishing protection zones. The MSS NRMC also concluded that authorizing bi-directional use in this band and sharing with GLONASS is feasible if the MSS downlink power flux density is limited, although the prospect of compatible co-channel operations in the six megahertz now occupied by and notified to the International Telecommunication Union (ITU) for GLONASS (1610-1616 MHz) will be somewhat limited.[19]

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[17] No party opposes this upgrade.

[18] In the Notice, we also recognized that WARC-92 upgraded the existing radio astronomy allocation at 1610.6-1613.8 MHz from secondary to primary and therefore proposed to upgrade the radio astronomy service to primary status in our domestic Table of Allocations. We are adopting this proposal to reflect the WARC-92 action.

[19] Some of the CDMA proponents indicate that they can operate in the entire 1610-1616 MHz band without exceeding the power-flux limits established at WARC-92. In fact Loral states that it can coordinate successfully with GLONASS and has submitted an interference analysis to support its claim. Ellipsat also supports the power-flux density limits we have proposed. However, Motorola states that it can operate only above 1616 MHz. The MSS NRMC determined that the ability to share the 1610-1616 MHz segment depends upon whether the aviation community is to rely upon the GLONASS system for aircraft approach and terminal communications, or only while "en-route." The international equivalent isotropically radiated power limits for mobile Earth stations were developed to protect use of GLONASS frequencies in the 1610-1616 MHz band when aircraft are "en-route." The MSS NRMC concluded that use of GLONASS "en-

21. The MSS proponents that plan to use CDMA techniques generally object to a secondary downlink allocation in this band, maintaining that a bi-directional spectrum allocation will make frequency coordination extremely difficult. Further, TRW contends that synchronizing its system with a bi-directional system would be extremely difficult. Motorola, however, continues to argue in favor of bi-directional operations in this band.[20] It contends that a secondary bi-directional allocation in the 1616-1626.5 MHz band is essential to accommodate its system and that its system design, because of its bi-directional use of the band, is more spectrum efficient.

22. The MSS NRMC did not reach agreement on a proposal for spectrum sharing that would allow all proposed systems to be fully accommodated. Instead, two independent proposals were included in the Committee Report.[21] One report was based upon a CDMA system architecture, with systems operating over the entire available bandwidth; the other was based upon dividing the spectrum into segments, with discrete band segments assigned to CDMA and TDMA/FDMA architectures. Although the specific method for sharing among systems remains to be determined, based on the record we conclude that bi-directional operations in the 1613.8-1626.5 MHz band are feasible, and accordingly provide a secondary allocation for space-to-Earth operations in this band.

23. Power-related Limits and Coordination Requirements. WARC-92 addressed permitted signal levels in terms of both equivalent isotropically radiated power (e.i.r.p) and power flux density (PFD) at the Earth's surface produced by transmissions to and from a satellite. Specifically, power-related limits and coordination and notification requirements for MSS and RDSS operations in the 1610-1626.5 and 2483.5-2500 MHz bands were

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route" applications is feasible. We intend to address this issue further in CC Docket No. 92-166.

[20] Loral has recently notified the Commission that it no longer seeks to use the 1613.8-1626.5 MHz portion of the band for bi-directional service. See Loral Comments dated December 4, 1992.

[21] See Final Report of the Majority of the Active Participants (which was supported by AMSC, CELSAT, Constellation, Ellipsat, Loral and TRW) of Informal Working Group 1 to the Above 1 GHz Negotiated Rulemaking Committee, Annex 1/Attachment 1 to the Committee Report; and Report of Motorola on Band Segmentation Sharing to Working Group 1 to the Above 1 GHz Negotiated Rulemaking Committee, Annex 1/Attachment 2 to the Committee Report.

added or modified. In ITU Radio Regulation number 753F (RR753F),[22] WARC-92 specified that the PFD levels of RR2566[23] for the 2483.5-2500 MHz space-to-Earth (downlink) band are to be used as a threshold to determine when coordination is required by space stations of the MSS and RDSS services with respect to terrestrial services. RR731E specifies e.i.r.p limits and coordination requirements for MSS and RDSS Earth-to-space (uplink) operations in the 1610-1626.5 MHz band.[24] In addition,

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[22] RR753F states "[t]he use of the band 2483.5-2500 MHz by the mobile-satellite and the radiodetermination-satellite services is subject to the application of the coordination and notification procedures set forth in Resolution 46 (WARC-92). Coordination of space stations of the mobile-satellite and radiodetermination-satellite services with respect to terrestrial services is required only if the power flux-density produced at the Earth's surface exceeds the limits in No. 2566. In respect of assignments operating in this band, the provisions of Section II, paragraph 2.2 of Resolution 46 (WARC-92) shall also be applied to geostationary transmitting space stations with respect to terrestrial stations." RR753F was formerly designated as RR753X.

[23] RR2566 provides that "[t]he power flux-density at the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the following values:

- 152 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- 152 + 0.5(δ-5)dB(W/m^2) in any 4 kHz band for angles of arrival δ(in degrees) between 5 and 25 degrees above the horizontal plane;
- 142 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane."

[24] RR731E states "[t]he use of the band 1610-1626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to the application of the coordination and notification procedures set forth in Resolution 46 (WARC-92). A mobile earth station operating in either of the services in this band shall not produce an e.i.r.p. density in excess of -15 dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. 732, unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, a value of -3 dB(W/4 kHz) is applicable. Stations of the mobile-satellite service shall not cause harmful interference to, or claim protection from, stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. 732 and stations in the

specific coordination and notification procedures are set forth in Resolution 46.[25] In the Notice, we proposed to adopt these international requirements.

24. Most commenting parties support our proposals for implementing the international power-related limits and the coordination and notification procedures. These parties agree that these requirements are appropriate measures to permit MSS to operate in the 1610-1626.5 and 2483.5-2500 MHz bands. Ellipsat and TRW, for example, express support for the power-related limits and coordination procedures adopted at WARC-92. Loral and Motorola agree that RR731E should be included in the domestic Table because it prescribes e.i.r.p. limits for these bands. Constellation and CELSAT, on the other hand, argue that the international footnotes adopted at WARC-92 should apply only to international operations and coordination and not to domestic operations. For example, Constellation argues that RR731E and RR753F should not be included in the domestic allocation because they are applicable only to international negotiations. CELSAT suggests that we pursue other options, such as limiting the total PFD in the bands; establishing a minimum PFD utilization per voice circuit per beam; establishing a PFD limit per licensed system; requiring that the PFD limit apply to peak power during any on-period for time-duplexed systems; or establishing a PFD allocation based on a reuse incentive for each licensee. CORF notes that RR733E requires that MSS uplink transmissions in the 1610-1625.5 MHz band not cause harmful interference to radio astronomy operations in the 1610.6-1613.8 MHz band.[26] Further, it states that any rules adopted by the Commission should limit emissions in the 2483.5-2500 MHz band so that spurious emissions do not cause harmful interference to radio astronomy operations in the 4990-5000 MHz band.

25. We find that the power-related limits and coordination requirements adopted at WARC-92 are the most suitable measures to assure compatibility between MSS and RDSS operations and other services. While CELSAT's suggestions might offer innovative approaches in some cases, we observe that the WARC-92 requirements were the result of extensive negotiations and technical analyses. RR731E and RR753F were intended to provide

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fixed service operating in accordance with the provisions of No. 730." RR731E was formerly designated as RR731X.

[25] Resolution 46 was formerly designated as Resolution COM5/8.

[26] RR733E states "[h]armful interference shall not be caused to stations of the radio astronomy service using the band 1610.6-1613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite services."

the basis for international notification and coordination of the various satellite systems and to assure that existing systems are afforded protection from harmful interference. Compliance with these Radio Regulations will assure MSS providers that they can use these bands and also will facilitate coordination in the international arena. In view of these considerations, we believe that the international rules for limits on power flux density and for coordination and notification will best assure that existing systems in the bands are protected from harmful interference. Therefore we are listing footnotes 731E and 753F in the domestic Table of Frequency Allocations. Accordingly, MSS operations in the 1610-1626.5 and 2483.5-2500 MHz bands will be subject to the e.i.r.p. and power flux density levels set forth in RR731E and RR2566, respectively. In addition, such MSS operations will be subject to the coordination and notification procedures set forth in Resolution 46. U.S. licensees must comply with these coordination requirements when they coordinate their respective systems internationally. We are also including footnote 733E in the domestic Table of Frequency Allocations to ensure that the radio astronomy service is protected.

26. To ensure that existing services are protected through the coordination procedures established at the WARC-92 and to conform our domestic Table of Frequency Allocations to the WARC-92 allocations we are amending the Table of Frequency Allocations by adding international footnotes 731E, 731F, and 753F; modifying international footnotes 733A, 733E, 734, 753, and 753C; and deleting international footnotes 731A, 731B, 731C, 731D, 753E, 877, 878, 890, and 891. Finally, we are amending non-Government footnote NG147 to reflect the allocation we are adopting.[27]

27. Feeder Links. In the Notice, we declined requests by the MSS LEO petitioners to propose specific new allocations for MSS feeder links. We stated that the existing fixed-satellite service (FSS) bands should provide sufficient capacity to serve the needs of MSS LEO feeder links and noted that these fixed satellite allocations can be used for feeder links, subject to normal frequency coordination.[28]

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[27] NG147 recognizes "grandfather" rights for fixed services in existence prior to the RDSS spectrum allocation decision. We are recognizing the right of these fixed services with regard to MSS as well.

[28] We also specifically declined to propose the 5150-5216 MHz (downlink) RDSS feeder link band for MSS or mixed MSS/RDSS feeder link use, as requested by Loral. We stated in the Notice that such use did not appear to be compatible with aeronautical radionavigation uses currently operating in the band.

28. The MSS LEO proponents continue to argue that specific feeder link frequencies should be provided for MSS LEO operation.[29] The MSS NRMC analyzed the need for additional spectrum for feeder links and concluded that using portions of the 6425-6725 MHz bands for uplink feeder operations, as proposed by some of the applicants, appears possible. However, it also concluded that difficulties may arise with respect to using 5150-5216 MHz for downlink feeder operations.[30] The MSS NRMC therefore examined all of the downlink FSS bands between 3 and 15 GHz and concluded that if the 5150-5216 MHz band is not available, the Commission should identify at least 66 megahertz between 3 and 15 GHz for assignment to MSS LEO satellite feeder links.[31] The MSS NRMC stated that such a band could be utilized in conjunction with its recommended uplink feeder link band at 6425-6725 MHz and identified possible alternative downlink bands at 3600-3700 MHz and 10.95-11.20/11.45-11.70 GHz.

29. We continue to believe that, at least initially, the existing FSS bands are sufficient to begin accommodating MSS feeder links. We note that there may be difficulties in using FSS bands that generally are congested with significant numbers of GEO FSS systems. Consequently, because of the significant coordination difficulties arising from the global nature of LEO operations, MSS LEO feeder links would need to operate in FSS frequency bands that are not heavily used by GEO FSS systems.[32]

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[29] See, e.g., Constellation at 9 and Ellipsat at 8.

[30] The FAA is proposing to implement new navigation aids in the 5150-5250 MHz band. These include Differential Global Positioning System (DGPS) and Automatic Dependent Surveillance (ADS). The MSS NRMC concluded that significant interference from DGPS and ADS into MSS LEO feeder link downlink frequencies may occur if the FAA planned systems are implemented. The FAA also stated to the MSS NRMC that the aviation community believes that there may be difficulty using these frequencies for MSS LEO feeder links outside the United States because they are allocated to aeronautical radionavigation on a worldwide basis.

[31] See Committee Report, supra note 12 at Annex 3, Section 4.1.1.

[32] The 6425-6725 MHz band is available now, but only in the Earth-to-space (uplink) direction. Another option might be to consider reverse band operations in certain FSS bands for feeder links to MSS systems only. Further, we have approached NTIA on the issue of using the 5150-5250 MHz band for MSS feeder links and NTIA stated in a letter on October 15, 1993, that they oppose use of this band for MSS feeder links but are willing to work with the Commission in defining and evaluating the various options to satisfy this need. We are placing a copy of this

30. In the Notice we noted that RR2613, as modified at WARC-92, effectively limits non-geostationary satellite operations to secondary status with respect to geostationary operations in the FSS bands.[33] We questioned the effect this rule would have on the availability of frequencies in the FSS bands for non-GEO MSS feeder links. MSS LEO proponents generally argue that this international rule was not intended to relegate non-GEO feeder links to secondary status because feeder links themselves are a fixed operation. COMSAT, Ellipsat, Loral, and Constellation all maintain that RR2613 does not affect the availability of FSS frequencies for MSS feeder links.[34] After study, the MSS NRMC concluded that sharing between non-geostationary and geostationary systems is feasible with prior coordination, but recommended that the U.S. seek international agreement that RR2613 would not be invoked to terminate operations of non-geostationary systems unless certain conditions were met.[35] We generally agree with the MSS NRMC's interpretation of RR2613 and intend to explore issues related to

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letter from Richard D. Parlow, Associate Administrator, NTIA to Thomas P. Stanley, Chief Engineer, FCC, into ET Docket 92-28. We also will consider the availability of the 3600-3700 MHz (space-to-Earth) or 10.95-11.20/11.45-11.70 MHz (space-to-Earth) as well as the 20/30 GHz bands.

[33] RR2613 states that "Non-geostationary space stations shall cease or reduce to a negligible level their emissions, and their associated earth stations shall not transmit to them, whenever there is insufficient angular separation between non-geostationary satellites and geostationary satellites resulting in unacceptable interference[1] to geostationary-satellite space systems in the fixed-satellite service operating in accordance with these Regulations." (note [1] states "The level of accepted interference shall be fixed by agreement between the administrations concerned, using the relevant CCIR Recommendations as a guide.")

[34] See COMSAT at 4; Ellipsat at 8; Loral at 18; and Constellation at 9.

[35] The MSS NRMC suggested that three conditions be met before RR 2613 can be invoked to require a non-GEO system to cease or reduce transmissions in order to protect a GEO system. First, the administrations of the systems involved must engage in bilateral or multilateral discussions and reach agreement as to a level of "accepted interference" (RR162). Second, after the systems are in operation, the non-GEO system must exceed the level of interference agreed to. Third, the interference in excess of the agreed level must be caused by the failure of the non-GEO system to maintain sufficient angular separation between the satellites of the two systems.

coordination between non-geostationary and geostationary systems in the appropriate international fora. Additionally, we will be investigating all options to ensure that adequate unencumbered spectrum is available for accommodating both immediate and future feeder link requirements.

31. Inter-Satellite Links. In the Notice, we proposed to adopt the inter-satellite service (satellite-to-satellite) frequency allocations approved internationally at WARC-92 for the 24.45-24.65, 24.65-24.75, 25.25-25.5, 25.5-27, and 27-27.5 GHz bands. No party objected to this proposal. However, based on discussions with NTIA, we conclude that the inter-satellite service links at 25.25-27.5 MHz were intended to be used only for government inter-satellite service operations and therefore in this proceeding we are not reserving these bands for use by non-government entities. However, we are including the inter-satellite service bands at 24.45-24.65 and 24.65-24.75 GHz and the already allocated inter-satellite service band at 22.55-23 GHz in the United States Table of Frequency Allocations for non-government use.

32. RF Radiation Limits. In the Notice, we expressed concern with the potential for MSS consumer devices to generate radiation that could harm human health. We observed that although the power levels likely to be used by most consumer devices in this service should be relatively low, in some cases, especially where hand-held units are used, emissions could be in close proximity to users and non-users. Since 1985 the Commission has used the 1982 RF exposure guidelines of the American National Standards Institute and the Institute of Electrical and Electronics Engineers (ANSI/IEEE) for evaluating environmental exposure to RF fields.[36] We recently proposed to adopt the new 1991 version of the ANSI/IEEE guidelines to replace the 1982 guidelines.[37]

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[36] See 47 C.F.R. § 1.1307(b). See also ANSI C95.1-1982, "American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz," American National Standards Institute.

[37] See Notice of Proposed Rule Making (RF Guidelines Notice), ET Docket No. 93-62, 8 FCC Rcd 2849 (1993); see also IEEE C95.1-1991, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" (1991 ANSI/IEEE Guidelines), approved September 26, 1991 by the IEEE, published April 27, 1992, and adopted by the ANSI November 18, 1992. The recommended compliance criteria for hand-held, low-power devices are set forth in terms of the device's radiated power or the specific absorption rate (SAR) created by the device. See Section 4.2 of the 1991 ANSI/IEEE Guidelines or the RF Guidelines Notice.

33. Motorola states that hand-held devices used for mobile satellite communications can operate safely within the provisions of the new ANSI/IEEE guidelines. Similarly, TRW states that it has developed hand-held transceivers for its MSS LEO system that will comply with the new ANSI/IEEE guidelines.[38] With respect to concerns that digital formats might be less safe than analog formats, TRW states that its system uses digital signaling formats with electromagnetic characteristics that are substantially the same as that of analog signals and that digital formats pose no greater risk with respect to RF exposure. TRW notes that non-geostationary spread spectrum CDMA systems propose to use low-power, hand-held devices that transmit at approximately 0.5 watts. CELSAT states that its handsets will operate at very low power levels, less than 0.1 watt average power, and that devices for its system that require higher powers will be operated far enough from the user to preclude any potential exposure hazard.

34. On the other hand, according to TRW, hand-held devices used in conjunction with geostationary MSS GEO systems might pose a health risk because they must transmit with higher power to communicate with satellites that are farther away. AMSC agrees that there is potential for some hand-held units used with MSS GEO systems to present a potential health hazard to humans. Its analysis of a 2-watt hand-held unit operating at 1613 MHz predicts a PFD flux density that would exceed the proposed new RF exposure guidelines. AMSC however states that its first generation system will use only vehicular-mounted units, and therefore that its proposed system poses no safety problem. AMSC states that the hand-held units to be used with its second generation system will comply with the proposed new RF exposure guidelines. Loral questions AMSC's analysis, maintaining that AMSC did not use the proper antennas, frequencies, and equations in arriving at its conclusions and did not correctly analyze RF hazards in accordance with the ANSI/IEEE guidelines. Loral submits that, in any event, we should use the new ANSI/IEEE guidelines in evaluating MSS systems. TRW, on the other hand, urges that we resolve issues related to RF exposure safety and MSS operations in a separate proceeding.

35. In view of the important health issues involved, the fact that no general manufacture of consumer equipment for MSS in

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[38] The 1991 ANSI/IEEE guidelines incorporate generally stricter criteria for hand-held transmitters operating in the range 450-1500 MHz. We requested the IEEE to address whether interpretation as to whether the formulas used to define exclusions based on radiated power can be used for frequencies up to 2.2 GHz. IEEE responded that use of the formula up to 2.2 GHz would be conservative.

these bands has yet begun, and our intent to provide for the expeditious initiation of the services for which this spectrum is being allocated, we believe the new ANSI/IEEE guidelines should be used when evaluating the potential for harm to public health from exposure to RF emissions of MSS user devices. If we modify the new ANSI/IEEE guidelines in ET Docket No. 92-62, those guidelines will be applied to MSS equipment. Rules adopted in the instant proceeding which do not conform with the final rules adopted in ET Docket No. 93-62 will be amended accordingly. Thus, for the purpose of type accepting equipment, we will require that all hand-held devices comply with the new ANSI/IEEE specifications for "uncontrolled" environments because the new MSS service as envisioned would include consumer use that would be within the "uncontrolled" definition.[39]

OTHER MATTERS

36. In the Notice, we elected not to propose to allocate a portion of the 1610-1626.5 and 2483.5-2500 MHz bands for a hybrid satellite and terrestrial personal communications service as requested by CELSAT, finding that the terrestrial component of such proposed use was not authorized in the international allocation.[40] CELSAT filed a Petition for Reconsideration of our dismissal of the portion of its Petition for Rule Making that

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[39] The 1991 ANSI/IEEE guidelines specify two sets of exposure recommendations, one for "controlled" environments and the other for "uncontrolled" environments. Controlled environments are "locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels" may be above the exposure and induced current levels permitted for the general public, but not those permitted for persons aware of the potential for exposure. Uncontrolled environments are "locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or work places where there are no expectations that the exposure levels may exceed "the exposure and induced current levels permitted for the general public."

[40] CELSAT also had submitted an alternative request for spectrum at 2120-2129 and 2410-2428 MHz. Recently CELSAT filed to amend its Petition for Rule Making and now is seeking an allocation for its hybrid satellite and terrestrial service in the 1970-1990 and 2160-2180 MHz bands. See Petition for Rule Making, RM-7927, filed February 6, 1992; Motion to Amend filed July 8, 1993.

related to these bands.[41] CELSAT argues that the satellite element of its proposal is severable from its terrestrial element and compatible with WARC-92 decisions.[42]

37. CELSAT misconstrues our proposal and treatment of its petition. Insofar as CELSAT requested a spectrum allocation for geostationary MSS, in the Notice we proposed to allocate this spectrum to MSS and explicitly noted that the proposal includes both geostationary and non-geostationary use. We declined only to propose an allocation that would authorize terrestrial use of these bands because terrestrial use is inconsistent with the international allocation adopted at WARC-92.

ORDERING CLAUSES

38. In accordance with the requirements of the Regulatory Flexibility Act of 1980, 5 U.S.C. Section 608, the Commissions Final Regulatory Flexibility analysis is set forth in Appendix A.

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[41] TRW filed a Motion to Dismiss CELSAT's Petition for Reconsideration, arguing that our action declining CELSAT's proposal in the Notice was not a final action and therefore not subject to a Petition for Reconsideration. We agree with TRW, but are treating CELSAT's filing as a comment and considering the substantive issues raised therein inasmuch as the filing would have been accepted if filed as a comment.

[42] We also note that on April 1, 1991, the Common Carrier Bureau issued a public notice inviting license applications in the 1610-1626.5 and 2483.5-2500 MHz bands and established a final date of June 2, 1991 for filing such applications. CELSAT did not file a license application by the June 2, 1991 cut-off date. See Public Notice, "Satellite Applications Acceptable for Filing: Cut-off Established for Additional Applications," Report No. DS-1068, 6 FCC Rcd 2083 (1991).

39. Accordingly, IT IS ORDERED, that Part 2 of the Commission's Rules and Regulations IS AMENDED as specified in Appendix B, effective 30 days after publication in the Federal Register. IT IS FURTHER ORDERED that TRW's Motion to Dismiss CELSAT's Petition for Reconsideration IS GRANTED IN PART; and that the Petition for Reconsideration filed by CELSAT IS ACCEPTED as a comment. This action is taken pursuant to Sections 4(i), 303(c), (f), (g), and (r), and 309(a) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 303(c), (f), (g), and (r).

FEDERAL COMMUNICATIONS COMMISSION

William F. Caton
Acting Secretary

Appendix A: Final Regulatory Analysis

Pursuant to 5 U.S.C. Section 603, an initial Regulatory Flexibility Analysis was incorporated in the Notice, in ET Docket No. 92-28. Written comments on the proposals in the Notice, including the Regulatory Flexibility Analysis, were requested.

Need for and Objective of Rules. The objective of our actions herein is to accommodate demand for voice and data services that can be provided by mobile-satellites in the 1610-1626.5 and 2483.5-2500 MHz bands. We expect that implementation of this new service will satisfy a growing demand for voice, data messaging, and position determination services at an affordable cost.

Issues Raised by the Public in Response to the Initial Regulatory Flexibility Analysis. Several parties suggested modifications to the proposals set forth in the Notice, although not specifically in response to the initial regulatory flexibility analysis. For example, several parties requested clarification of the applicability of the international footnotes on the domestic allocation and the feeder link frequencies that could be utilized for delivery of non-GEO MSS. As a result, we have made appropriate modifications to our proposals and clarified the points raised in the comments.

Any significant Alternative Minimizing Impact on Small Entities and Consistent with Stated Objectives. The alternative to allocating these bands to MSS is to accommodate this service in other spectrum. After balancing the needs of the MSS service with the option of allocating other spectrum for this service, we conclude that the bands proposed are most desirable for MSS, are compatible with the international allocation, and are suitable for sharing with existing operations.

Appendix B: Rule Changes

I. Part 2 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 2 - - FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS: GENERAL RULES AND REGULATIONS

1. The authority citations in Part 2 continues to read:

AUTHORITY: Sec. 4, 302, 303, and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154, 154(i), 302, 303, 303(r), and 307, unless otherwise noted.

2. Section 2.106, the Table of Frequency Allocations, is revised for the 1610-1626.5 MHz, 2483.5-2500 MHz, 22.5-23 GHz, and 24.25-24.75 GHz bands, in accordance with the following:

Section 2.106 Table of Frequency Allocations

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International Table			United States Table		FCC use designators	
Region 1 Allocation MHz	Region 2 Allocation MHz	Region 3 Allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule Part(s)	Special-Use Frequencies
(1)	(2)	(3)	(4)	(5)	(6)	(7)
*	*	*	*	*		
1610-1610.6 AERONAUTICAL RADIONAVI-GATION. MOBILE-SATELLITE (Earth-to-space). 722 727 730 731 731E 732 733 733A 733B 733E 733F	1610-1610.6 AERONAUTICAL RADIONAVI-GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). 722 731E 732 733 733A 733C 733D 733E	1610-1610.6 AERONAUTICAL RADIONAVI-GATION. MOBILE-SATELLITE (Earth-to-space). Radiodeter-mination-Satellite (Earth-to-space). 722 727 730 731E 732 733 733A 733B 733E	1610-1610.6 AERONAUTICAL RADIONAVI-GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). 722 731E 732 733 733A 733E US208 US260 US319	1610-1610.6 AERONAUTICAL RADIONAVI GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). 722 731E 732 733 733A 733E US208 US260 US319	AVIATION (87). SATELLITE COMMUNICATION (25).	
*	*	*	*	*		

Section 2.106 Table of Frequency Allocations

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International Table			United States Table		FCC use designators	
Region 1 Allocation MHz	Region 2 Allocation MHz	Region 3 Allocation MHz	Government Allocation MHz	Non-Government Allocation MHz	Rule Part(s)	Special-Use Frequencies
(1)	(2)	(3)	(4)	(5)	(6)	(7)

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1610.6-1613.8 AERONAUTICAL RADIONAVI-GATION. MOBILE-SATELLITE (Earth-to-space). RADIO-ASTRONOMY. 722 727 730 731 731E 732 733 733A 733B 733E 733F 734	1610.6-1613.8 AERONAUTICAL RADIONAVI-GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). RADIO-ASTRONOMY. 722 731E 732 733 733A 733C 733D 733E 734	1610.6-1613.8 AERONAUTICAL RADIONAVI-GATION. MOBILE-SATELLITE (Earth-to-space). RADIO-ASTRONOMY. Radiodeter-mination-Satellite (Earth-to-space). 722 727 730 731E 732 733 733A 733B 733E 734	1610.6-1613.8 AERONAUTICAL RADIONAVI-GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). RADIO-ASTRONOMY. 722 731E 732 733 733A 733E 734 US208 US260 US319	1610.6-1613.8 AERONAUTICAL RADIONAVI-GATION. RADIODETER-MINATION SATELLITE (Earth-to-space). MOBILE-SATELLITE (Earth-to-space). RADIO-ASTRONOMY. 722 731E 732 733 733A 733E 734 US208 US260 US319	AVIATION (87). SATELLITE COMMUNICATION (25).	

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